Comments on Combination of Problem-Based Learning and Immunological Concepts Teaching in Veterinary Immunology Education: A Brief Review

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Abstract: The educational method Problem-Based Learning (PBL) has been spread around the world in medicine and health sciences and proved to be a successful education strategy in many different study domains all over the world. Considering the abstraction and difficult understanding of immunological concepts and theory, combination of PBL and Immunological Concepts Teaching (ICT) has been developed in veterinary immunology education in Northwest A&F University for many years. This review described the curriculum design and effect of this approach in this subject. The teaching approach combined PBL and ICT could effectively deepened understanding of immunological concepts and theories, inspired students’ learning interest, expand learners’ thinking, cultivated their team and cooperation consciousness and improve ability of knowledge acquisition. This review would have important implication for education of veterinary immunology and other veterinary subjects in this university and other colleges or universities all over the world.

Key words: Problem-based learning, immunological concepts teaching, veterinary immunology education, thinking, China

INTRODUCTION

Veterinary immunology is one of the required subjects and core curriculums for students in veterinary medicine major together with veterinary microbiology, veterinary lemology, veterinary parasite and parasitosis. This curriculum lays particular emphasis on immunodiagnosis, immunoprophylaxis and immunotherapy which has important implication in prevention and control of animal disease (Rose, 1969; Brunner, 1996; Lunney et al., 2002; Enrican et al., 2009). And the development and education of veterinary immunology represents the control level of animal disease in one country.

Teaching strategies used to assist learners in learning the fundamental principles and concepts are essential to the education of veterinary immunology. Among many methods used previously in education of medicine, veterinary medicine and other fields (Tavakol et al., 2009; Wang et al., 2010; Applin et al., 2011), the Lecture-Based Learning (LBL) is the most widely used and accepted teaching method in education of veterinary immunology in China. The LBL is a teacher-centered approach and has the noted advantage that could facilitate the learners’ ability to master and retain a wide variety of information (Engel, 1991; Sunbaldjet al., 2002; Applin et al., 2011). But this technique has been described less effective for learning in medical educations since, it makes learners frequently as a passive information receiving role and does not facilitate cultivation of students’ essential skills in practicing professionals such as knowledge application and critical thinking (Kumar, 2003; Applin et al., 2011). In 1969, a novel educational strategy, Problem-Based Learning (PBL) was firstly introduced and applied in the domain of medicine at McMaster University (Barrows, 1985).

The PBL is based on the process of working towards the understanding or resolution of a problem which converts teacher-centered to be learner-centered, inspires learners’ initiative and learning interest, improves learning efficiency and ultimately promotes lifelong learning (Neville and Norman, 2007; Neville, 2009; Wang et al., 2010). At present, PBL teaching has been widely adopted in medical education in Europe, America and Asia. In China, many medical colleges and universities have been using this strategy in whole or in part in educations of medical immunology, medical microbiology, medical ethics and clinical curriculums such as nursing, neurobiology,

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obstetrics and internal medicine (Kwan, 2004; Cohen-Schtomas et al., 2008; Wang et al., 2010). In education of veterinary medicine although, there are few reports on PBL teaching (Rivarola and Garcia, 2000; Cox, 2001; Howell et al., 2002; Lane, 2008; Schmidt et al., 2008), no report in veterinary immunology teaching was found prior to this review. In Northwest A&F University in Northwestern China, the PBL teaching has been successfully used in education of veterinary immunology for many years. Considering the abstract and difficult understanding of immunological concepts and theories, combination of PBL and Immunological Concepts Teaching (ICT) was developed in veterinary immunology education in this university. This review described the curriculum design and effect of this approach in veterinary immunology education with the chapter Antigen as example and main comments on this combination technique in this curriculum education were also discussed.

**CURRICULUM DESIGN AND EFFECT OF COMBINATION OF PBL AND ICT IN THE CHAPTER ANTIGEN OF VETERINARY IMMUNOLOGY**

A total of 28 students in the same class were divided into four groups with one monitor in each group. The planned time of the chapter Antigen was six credit hours (2 h one time and two times 1 week) with 2 days interval between two times in 1 week. At the first 2 h, the LBL method was used to teach the immunological concepts of antigen and its two characteristics (Immunogenicity and antigenicity) in detail. Then, one question related to clinical case was given to each group, respectively. The question for the 1st group was to explain that animals vaccinated by whole inactivated bacteria could obtain high level antibody against this bacteria infection but could not get protected by some purified components of the same bacteria. The question for the 2nd group was to tell the possible reasons that animals could not acquire antibody by injecting antibiotics but could obtain antibody by injection of vaccine. The question for the 3rd group was to explain that different levels of antibodies were obtained by different pig vaccinated with the same vaccine. The question for the 4th group was that whether use only one component or whole bacteria to detect antibody level of animal vaccinated with only this component. Students were given 2 days to look up materials and thinking. At the second 2 h, students were organized to discuss and debate within group and among groups and provide new other questions related to these cases. At the third 2 h, the presentation of answers for the questions was given by the monitor or anyone in each group, then teacher evaluated answers group by group and provide real-time analysis and discussion.

The combination of PBL and ICT teaching approach successfully stimulated learners’ interest in learning veterinary immunology. Students under this approach deeply understood the contents of antigen, immunogenicity, antigenicity, vaccine, epitope and other related concepts. The process of material reading and problem solving also made students comprehend the immune programs for different animals and grasp the possible causes leading to failure of immune response and factors that affect the immunity to pathogenic agents.

**COMMENTS ON COMBINATION OF PBL AND ICT IN VETERINARY IMMUNOLOGY EDUCATION**

Understanding of immunological concepts and theories deepened by combination of PBL and ICT: For many students, the veterinary immunology is one of the most difficult curriculums because of abstract contents of concepts. Therefore, the concept teaching appears very important to learners. In the teaching of chapter Antigen, 2 credit hours were spent to detail explain the immunological contents of antigen and its two characteristics (Immunogenicity and antigenicity) which enable students to preliminarily understand of these concepts. To further prehension these concepts, PBL teaching was used. Students could grasp the physicochemical property of antigen molecules through compared the immunogenicity of whole bacteria and purified components of this pathogen. And the concepts of complete antigen and hapten are easily comprehended by analyzed different immune response to medicine and vaccine. Hence, the application of combination of PBL and ICT in chapter Antigen provides a successful and effective example for veterinary immunology education.

**Students’ subjective motility and learning autonomy stimulated by PBL:** PBL, one effective learning approach with the problem encountered first in the learning processes as well as for the search for the information or knowledge needed to understand the mechanisms responsible for the issue and how it might be (Applin et al., 2011). The active cases and questions changed dried and metaphysical traditional teaching mode, promoted students’ interest and desire in courses, motivated learners’ self-directed learning to find resolution to solve doubts and enhanced lifelong learning behaviors. For example to solve the question to the 4th group that whether use only one component or whole
bacteria to detect antibody level of animal vaccinated with
only this component, students' subjective motility and
learning autonomy were effectively stimulated by this
student-centered teaching mode. Through widely reading
materials and discussion with classmates, students not
only could get answer to question by themselves but also
understand that the specificity of antigenicity is
determined by molecular structure of antigen. Therefore,
students under PBL teaching are more likely to be good at
reasoning and critical thinking, structure knowledge and
problem solving using immunological principles in clinical
cases.

Thinking mode expanded by combination of PBL and ICT:
Commonly, the thinking mode of students in veterinary
medicine major is longitudinal and instrumental compared
with clinical veterinarians with lateral and integrative
mode. The teaching approach combined PBL and ICT
promotes students to consult textbooks and related
documents or inter-discusses with classmates, the
process of which may involve all aspects related to the
specified cases and correlate with knowledge in clinic and
other subjects. Students under this teaching technology
can be facilitated in applying and consolidating learning
knowledge and cultivating comprehensive application of
skills and lateral thinking. Meantime, this teaching method
strengthens the veterinary students' exploring and
creative thinking. For the question of 3rd group in the
teaching of chapter Antigen that what was the possible
reasons for different levels of antibodies obtained by
different pig vaccinated with the same vaccine, several
students have promoted some interesting questions
beyond the curriculum but related to veterinary
immunology and some students even use principles of
natural immunity and adaptive immunity (These contents
should be taught in the following study) to explain this
unusual phenomenon.

Team and cooperation consciousness strengthened and
ability of knowledge acquisition improved by combination
of PBL and ICT: The team and cooperation
consciousness are important in practicing professionals
(Engel, 1991; Sunbald et al., 2002; Applin et al., 2011). The
teaching approach combined PBL and ICT is based on
cooperation of students within and among groups. The
ultimately solution of questions are depended on effort
and thinking mode of each student which represent the
congregate intelligence. In addition to collect all the
information related to these cases, students have to look
up materials from books, journals, internet and other
sources whether published in Chinese or English. These
processes trained the students' abilities of oral
expression, document consulting, search engine using
and English reading and comprehending.

Drawbacks of combination of PBL and ICT in veterinary
immunology education: Although, the teaching approach
combined PBL and ICT has been presented many
advantages in veterinary immunology education, it also
has a few drawbacks. This method is not limited in
textbooks but has no ready-made teaching materials
which would make knowledge system look dispersive and
unclear. The small-group and problem-based learning
style will need a great number of practiced teachers and
much more time spent on the collection of materials for
students will decrease learning time on other subjects.
Therefore, the solution of these problems would be the
main focus in the future study.

CONCLUSION

The combination of PBL and ICT, learner-centered
teaching approach could effectively inspired students’
learning interest, expand learners’ thinking and cultivate
their team and cooperation consciousness which has
played important role in reform of instruction in veterinary
immunology education and is welcomed by students. The
further application of this approach in this curriculum and
other veterinary subjects has important implication for
education of veterinary medicine.

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REFERENCES

problem-based learning and non-problem-based

Barrows, H.S., 1985. How to Design a Problem-Based
Curriculum for the Preclinical Years. Springer, New
York, USA., Pages: 148.


